



Early Journal Content on JSTOR, Free to Anyone in the World

This article is one of nearly 500,000 scholarly works digitized and made freely available to everyone in the world by JSTOR.

Known as the Early Journal Content, this set of works include research articles, news, letters, and other writings published in more than 200 of the oldest leading academic journals. The works date from the mid-seventeenth to the early twentieth centuries.

We encourage people to read and share the Early Journal Content openly and to tell others that this resource exists. People may post this content online or redistribute in any way for non-commercial purposes.

Read more about Early Journal Content at <http://about.jstor.org/participate-jstor/individuals/early-journal-content>.

JSTOR is a digital library of academic journals, books, and primary source objects. JSTOR helps people discover, use, and build upon a wide range of content through a powerful research and teaching platform, and preserves this content for future generations. JSTOR is part of ITHAKA, a not-for-profit organization that also includes Ithaka S+R and Portico. For more information about JSTOR, please contact support@jstor.org.

ARTICLE IV.

Remarks on the Dental System of the Mastodon, with an Account of some Lower Jaws in Mr. Koch's Collection, St. Louis, Missouri, where there is a solitary Tusk on the right Side. By W. E. Horner, M. D., Professor of Anatomy in the University of Pennsylvania. Read Nov. 6, 1840.

THE extinction of an animal having so many claims to our curiosity as the Mastodon, from its localities—its conformation, and its colossal magnitude—an extinction so complete and final that its fiat has reached not only all the individuals of that genus, but also extended its fatal influence to cognate genera of every description without exception, is an event in the revolutions of the earth so confounding, that the mind is lost in seeking for a cause, and dwells on the circumstance with astonishment and awe. An insatiable desire exists for further knowledge on the subject; and we are pleased with almost any attempt to explore the probable history and habits of these animals—their peculiarities of structure—the modifications of development, dependent on their species and genera—and, finally, the particular catastrophe which overwhelmed them at once, or, by a sequence of physical changes in atmosphere and food, brought about their ultimate destruction. It is upon this ground that I propose to offer a few remarks on the Dentition of the Mastodon.

The data from observations already made, on the phenomena of dentition in these animals, leave the inference that, mechanism and texture excepted, a very close analogy existed between the development of their teeth and those of the Elephant. In the mechanism of the tooth of the Elephant we find vertical, transverse strata of bony matter and of enamel, alternating with one another, and depending for their relation upon an original arrangement of the pulp of the tooth and of its capsule well known to anatomists, and which is partially

represented by extending the fingers of the two hands, and thrusting them, point to point, between each other. In the Mastodon, besides the division of the triturating surface into denticules, the mechanism resembles that of the human tooth, by the enamel covering completely the crown or body of the tooth, and not being arranged into those transverse vertical layers. The texture of the Mastodon teeth is also closer, or more compact. In both instances the teeth are formed by excretion, and though chemically of similar materials with bone, to wit, calcareous and animal matter, yet they differ organically from it in their mode of production, in their manner of growth, and in their texture. As the result of an excretion, they are destitute of cancellated structure, are in successive laminae, enclosing one another, and have no blood-vessels penetrating into and diffusing themselves in their texture. They are therefore absolutely inorganic, though porous and filamentous,* and have within themselves neither a power of repair nor of growth. It hence arises that, being of a fixed size, dependent on the size and excretive power of their original germs, such size, which is adequate to the process of mastication in an ungrown animal, is inadequate as the animal increases in magnitude, and a supplementary provision is therefore called for.

The shoulders of a Mastodon, at birth, had a diameter not exceeding, probably, sixteen inches, by about twenty, to enable it to pass through the pelvis of the female, but its full grown state is that of the largest Elephant. Allusion is here made chiefly to the living *Elephas Indicus*. Remains of fossil Elephants have been found near Verona, in Italy, which indicate a stature of fifteen feet high, so far as a correct conclusion can be formed from an examination of the lower jaw, and a metacarpal bone. A tusk was found there twelve feet long, by nine inches in diameter.† There are, as yet, no exhumations of the Mastodon which exhibit such altitude; the tallest of which we have the remains did not exceed thirteen feet; it is probable, however, that the bulk was not inferior, as the Mastodon appears to have been a stouter animal than the elephant in proportion to its height.

Remains of fossil Elephants have been found in several other parts of Italy, France, Germany, Holland, and Belgium, under circumstances which leave the persuasion that such animals were once indigenous to Europe. The largest

* See Retzius on Teeth.

† Cuvier Ossen. Fossils, Art. Elephans, page 11. Paris, 1812.

skeleton was probably that which was raised near the Castle of Chaumont, in France, about the year 1613. Its thigh bone measured five feet in length, and its tibia four feet. It passed for the remains of Teutobochus, king of the Cimbrians, who had fought against the Roman general Marius, about one hundred years before Christ. Many publications for and against their authenticity as such, appeared at that time.

We may infer from the preceding remarks how great must be the changes in a dental system in passing from the calf to the adult, so as to secure at all periods a masticating surface of sufficient extent. The process of nature in providing this surface consists in bringing forward, from the back of the jaw bones, a series of teeth, successively larger and larger; and as these teeth emerge from behind, the smaller teeth advance forwards to near the chin, and their alveolar processes are absorbed. The advanced teeth, having no longer the latter support, then drop out.

The teeth, from their inorganic character, suffer less in the influences from time and atmosphere than any other portions of the animal frame; hence they are the last vestiges of individuals. They are also, in many instances, the last traces of races of animals, and our only idea of the latter is furnished upon the analogies of the teeth. The Mastodon, in some of its species, comes under this category: there is no remaining evidence, in certain cases, but the teeth, and in others only the teeth and the lower jaw, the latter seeming to be next to the teeth, in the character of indestructibility. To the naturalist, therefore, it is of consequence to have such a system of dentology as will enable him, on the one hand, to separate different species, and, on the other hand, to avoid the error of multiplying them, contrary to the order of nature.

A distinct species may be ascertained by the number of teeth in the jaw of a mature animal, and by their texture and mechanism. But as different periods of time, between birth and the mature or adult state, exhibit different numbers of teeth, a species, it is clear, cannot be determined upon their number alone, until we know the number existing at each age. Age may also have its peculiar concomitants of mechanism and texture; and, likewise, sex may affect the dental system of the Mastodon, as it does in other animals. In fine, with such narrow limits for correct judgment, the naturalist is much exposed to error, and it would perhaps be safer, in the present state of our knowledge in regard to the facts of dentology in the Mastodon, to refrain from admitting the existence

of new species except when the most positive evidences of difference in the texture and number of the teeth existed. In regard to the latter, it may be very safely asserted, that it is yet doubtful what was the entire amount of teeth protruded in the Mastodon, from the beginning to the end of its dentition; what were the teeth which were cotemporaneous, the periods of life of their existence, the peculiarities of sex, and, lastly, the irregularities of dentition in individuals.

The teeth of the Mastodon are all formed upon one type of configuration, the number of denticles excepted; they, therefore, like those of the elephant, do not admit of the division into incisors, cuspidate, and molars, as in some other animals. The teeth are, in fact, all molars. The lower jaw itself resembles somewhat a human lower jaw, cut off in front of the molar teeth, and there joined in the two posterior segments. These teeth invariably succeed each other from behind, as stated; the hindmost ones as they emerge, pushing the others forward, and out of their places, until the latter all drop out, and a large, solitary tooth is finally left on each side of each jaw.

The progress of dentition in the elephant is said to be as follows: the first teeth protrude at eight or ten days after birth, and are fully out at three months. The second are completely protruded in two years from birth, and fall out at six years. The third teeth appear at two years, and the fourth at nine years. The entire succession brings forward eight teeth on each side of each jaw, or thirty-two in the whole set. The periods at which the fifth, sixth, seventh, and eighth teeth protrude, are not so well known; it is ascertained, however, that the intervals of succession go on increasing. Such may have been the case exactly with the Mastodon.

The early ideas of naturalists on the teeth of the Mastodon were very extravagant. Buffon, for example, supposed, from their rectangular form, that they were very numerous; and having only insulated specimens of large teeth to form a judgment on, he concluded that we might infer how enormous would be the size of a head which had twenty-four or even sixteen teeth, each of which weighed ten or eleven pounds, (*Epoques de la Nature*. Note Justif. 9.) He made the double mistake of supposing that all the teeth were of the same magnitude, and that the entire set was co-existent in the animal. We now know, with some degree of certainty, that the earliest teeth of this animal were not more than an inch and a half square, and that the three immediately suc-

cessive teeth were a gradual and successive enlargement upon this and each other's volume. In the Museum of Mr. Koch at St. Louis, there is a young head, the long diameter of which is eighteen or twenty inches, and where the fact of four co-existent teeth on each side of each jaw, is exhibited. This specimen, with a dozen lower jaws of different ages and sizes, enables us to trace with some accuracy the stages of dentition until it reaches the large solitary grinder of ten inches in length, and on each side. Judging from these phases of dentition, I should infer that the entire amount of teeth was at least twenty-four.

M. Cuvier had satisfied himself, that the number was at least twelve, and he had almost reached the conclusion, from a comparison of publications, that there were sixteen. To our learned colleague, Dr. Isaac Hays, we owe *a further* conclusion on this subject, to wit, that the number was twenty-four.* I am, indeed, not satisfied, on viewing the difference of size between the smallest and the largest tooth of the Mastodon, that the number did not approximate still more that of the Elephant, and amount to at least twenty-eight, and, possibly, thirty-two.

Among the remarkable observations on the Mastodon, is that of Dr. Godman,† that there were examples of this animal having a short tusk on each side of the chin, and which he named Tetracaulodon. The existence of these tusks in unquestionably adult specimens, as demonstrated by Dr. I. Hays,‡ quashed the objection that they belonged to the sucking state, and were lost as the animal advanced to maturity. The naturalist was left therefore with the conclusion that either a new species of the animal had been discovered, or that it was merely a sexual peculiarity belonging most probably to the male. The perfect similitude of the other teeth with those of the known Mastodon, embarrasses this question deeply, and it may be safely doubted whether we have the materials to solve it.

In examining the specimens of the lower jaw, in Mr. Koch's Museum in St. Louis, I was struck with some, bearing on this question, and of which there are

* Description of the Inferior Maxillary Bones of Mastodons. Transactions of the American Philosophical Society, Vol. IV. New Series.

† Transactions of the American Philosophical Society, Vol. III. New Series, p. 478.

‡ Loc. cit. p. 22.

three. The first is a large adult with two of the largest class of molars on each side: it is perfect, with the exception of a small fractured surface of the left anterior part of the chin. This specimen has a lower maxillary tusk, twenty lines in diameter and five inches long. It protrudes from the anterior right side of the chin, and is directed horizontally. There is not the smallest indication of there ever having been a similar production from the left side of the chin, the fracture of which has not been deep enough to remove such vestiges, had they existed. The second specimen is also an adult lower jaw of the same size, in which the whole of the chin and the left half of the bone remain. In the right side of the chin, there is a horizontal alveolus, the size of the preceding; the tusk is not in it, but there is a loose one in the cabinet which may have belonged to it. In this jaw there is no corresponding alveolus, or even a vestige on the left side. The third specimen is the chin alone, of a very young and small animal, it is three inches in length by one and a half wide, is fossilized, and cemented thereby to a fragment of limestone about its own size. Here an alveolus for an inferior maxillary tusk exists also for the right side, but not on the left.

The dentition of these three specimens is, by a very curious coincidence, not symmetrical, that is, a tusk exists only on the right side of the chin in each. The questions in regard to the *Tetracaulodon* of Godman, are rendered still more embarrassing by their existence; for are we to consider them merely as abnormal types of that animal—as known *Mastodons*—or as still another species, to which, if such, the name of *Tricaulodon* might be attached? I confess myself unable to suggest a probable solution of this difficulty. Connected with it is, in fact, another: Mr. Koch has the lower part of the head of a *Mastodon* of middling size in which, from the intermaxillary bone, as usual, protrudes a tusk; but the tusk exists only on the left side, there being not even a vestige of alveolus on the right. We are informed by Tavernier, that some examples of the *Elephas Indicus* have but one tusk; are we, then, to consider this head as an abnormal instance of the common *Mastodon*, or is there really an extinct animal, which has an inferior maxillary tusk on the right side, and a superior maxillary on the left? Each jaw sacrificing one tusk.

The minute anatomy of the teeth, as exhibited by the microscope, has latterly been a very favourite object of study. The unquestionable result appears to be, that there are well established differences of texture in different animals,

depending upon the osseous filaments entering into their composition, and upon the direction and branching of certain tubes between these filaments.* While we are waiting for the exhumation of more heads of the above animals, possibly a microscopic examination of teeth and of tusks may serve to clear away some of the mysteries which obscure these problems in the extinct race, of which we have been treating.

These details and difficulties, apparently trivial, will perhaps be excused when we recollect that a single print of the cranium of a fossil Elephant, found in Siberia, and published seventy years before by Messerschmidt,† gave to the great Cuvier his first idea on the Theory of the Earth and of its changes, and caused him to execute the work which stood highest in his own estimation, to say nothing of the approbation which it has received from the scientific world, to wit, the *Oss. Fossiles*.

* See Muller's Archives for 1837, for an account of the Danish work of Professor Retzius, of Stockholm. The reader may for these, and other investigations on the same subject, consult also with advantage a Compilation called *Researches, &c., on the Teeth*, by A. Nasmyth. Lond.: 1839.

† *Transactions Philosoph.* Vol. XI. p. 446.